Subject: OPTOELECTRONICS AND COMMUNICATION

Time: 3 Hours | **DECEMBER 2010** | **Max. Marks: 100**

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after half an hour of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. An optical fibre has core & cladding refractive indices of 1.55 & 1.50 respectively. The numerical aperture of the fibre is

(A) 0 **(B)** 1
(C) 0.394 **(D)** 0.493

b. The wavelength of a light wave in free space for a frequency of 600 GHz & velocity, $3\times10^8 \, m/sec$ is

(A) 1 μm **(B)** 0.5 μm
(C) 1.5 μm **(D)** 2 μm

c. A step index fibre has a core diameter of 200 μm & NA = 0.29. The number of propagating modes at an operating wavelength of 850 nm is

(A) 100 **(B)** 22953
(C) 35922 **(D)** 10,000

d. The permittivity of the fibre core is 2.56, diameter = 1cm, $\mu_2 = 1$ & cut – off number = 2.4048. The maximum frequency of the dominant mode is

(A) 18.373 GHz **(B)** 81.373 GHz
(C) 373.81 GHz **(D)** 373.18 GHz

e. The optical power after propagating through a fibre of 450 m length is reduced to 30% of it's original value. The fibre loss in dB/ km is

(A) 26.11 **(B)** 11.62
(C) 1000 **(D)** 0

f. The intermodal dispersion per km for a fibre with $\Delta = 2\%$ & $\mu = 1.5$, is

(**A**) 100 ns (**B**) 001 ns
(**C**) 1000 ns (**D**) 0 ns

g. When a LED in applied with 2V, draws a current of 100 mA & produces 2mW of optical power. The conversion efficiency of the LED is

(**A**) 0% (**B**) 100%
(**C**) 1% (**D**) 50%

h. Germanium has a bandgap of 0.667eV. A germanium PIN diode has a cut – off length of

(**A**) 1.86 μm (**B**) 18.6 μm
(**C**) 0.186 μm (**D**) 1861 μm

i. An LED with a fibre pigtail of diameter 200 μm couples power into a 50 μm graded index core coupling loss is.

(**A**) 1 dB (**B**) 12 dB
(**C**) 0 dB (**D**) 24 dB

j. The velocity of light in an optically active medium with a refractive index of 3.6 is

(**A**) 3.38×10^7 m/s (**B**) 33.8×10^7 m/s
(**C**) 8.33×10^7 m/s (**D**) 3×10^7 m/s

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Discuss the significance of any **FOUR** of the following terms in optical fibres. **(8)**

(i) Snell's law
(ii) Acceptance angle
(iii) Numerical aperture
(iv) Skew rays
(v) V number

b. Draw a block diagram of a general optical communication system. Explain the blocks which are different from an electronic communication system. **(8)**

Q.3 a. What is the physical significance of eye diagrams and also explain different Eye pattern features. **(8)**

b. Compare various coherent detection techniques. **(8)**

Q.4 a. What is intermodal dispersion? Derive an expression for rms impulse due to intermodal dispersion with respect to multimode step index fibres **(10)**

b. Write a short note on
(i) Scattering.
(ii) Absorption.
(iii) Dispersion shifted fibers. **(6)**

Q.5 a. What do you understand by lensing scheme. Explain different lensing schemes for coupling improvement. **(10)**

b. Compute the macrobend loss of a single mode fibre with core diameter of $10\,\mu m$ & cut off wavelength 1250 nm, which is bent into a curve of radius R = 1.2 cm. the refractive index is 1.4469. Also, calculate the mode field diameter. Take $\lambda = 1.3\ \mu m$ **(6)**

Q.6 a. Discuss the principle of operation & applications of **(10)**
(i) Fabry – perot filters
(ii) Mach – zehnder interferometer

b. A fibre of 100 km long is used in a communication system. The fibre has a loss of 3.0 dB / km. What will be the output power when the power fed at the input of the fibre is 500 μW **(6)**

Q.7 a. What are the key requirements for analyzing a link and system considerations to establish a link power budget. **(8)**

b. What is the importance of rise time budget, derive an expression for total rise time system. **(8)**

Q.8 a. What are the basic elements of an analog link and how noise contribute this link. **(6)**

b. How do we analyze the performance of analog and digital systems and also examine a single-channel amplitude-modulated signal sent at baseband frequencies. **(10)**

Q.9 a. With necessary diagrams, explain SONET frame structure. **(10)**

b. Explain how optical trace & optical alarms assist in network management. **(6)**